

Reducing the risk of type 2 diabetes - multiple risk factor interventions

Note: No reviews of multiple risk factor interventions to prevent type 2 diabetes were located. These tables summarise the findings from individual studies.

Diabetes 1

Bibliographic information	Design & Methods	Findings
<p>Title: Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin.</p> <p>Authors: Diabetes Prevention Program Research Group (Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA and Nathan DM).</p> <p>Date: 2002.</p> <p>Publications details: The New England Journal of Medicine, vol. 346, no. 6, pp. 393-403.</p>	<p>Research objective: To evaluate whether a lifestyle intervention (diet and physical activity) or the administration of the drug, Metformin, would prevent or delay the development of diabetes.</p> <p>Design and setting: RCT clinical trial. United States</p> <p>Participants: 3234 non-diabetic people with elevated fasting glucose (mean age=51, mean BMI=34). Majority of participants were women (68%) Almost half were from minority groups (45%) Mean follow-up time =2.8 years.</p> <p>Intervention(s): The intervention was conducted in health care settings and involved education, advice and behaviour modification skills to help participants maintain a low fat diet, lose weight (goal of 7% weight loss) and moderate intensity physical activity (such as brisk walking) for 150 mins/week. 16 lesson curriculum taught on a one-to-one basis during the first 6 months. Program was flexible, individualised and culturally sensitive. Participants attended regular 3-monthly individual and group behaviour modification and support sessions.</p>	<p>Outcome measures: type 2 diabetes (glucose tolerance and fasting plasma glucose test). Other measures: daily physical activity (MET-hours per week) and daily caloric intake from fats, carbohydrates, protein and other nutrients (food frequency questionnaire)</p> <p>Results: 58% risk reduction in intervention group and 31% using the drug Metformin as compared to the placebo. To prevent one case of diabetes during a 3-year period, 6.9 persons would have to participate in the lifestyle intervention program.</p> <p>Conclusion: Lifestyle interventions are more effective than drugs in the prevention of type 2 diabetes in high risk groups. The results emphasise the importance of lifestyle interventions in the prevention of type 2 diabetes.</p>

Diabetes 2

Bibliographic information	Design & Methods	Findings
<p>Title: Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance.</p> <p>Authors: Tuomilehto J, Lindstrom J, Eriksson JG, Valle TT, Hamalainen H, Ilanne-Parikka P, Keinanen-Kiukaanniemi S, Laakso M, Louheranta A, Rastas M, Salminen V and Uusitupa M.</p> <p>Date: 2001.</p> <p>Publications details: The New England Journal of Medicine, vol. 344, no. 18, pp. 1343-1350.</p>	<p>Research objective: To determine the feasibility and effects of a lifestyle intervention to prevent type 2 diabetes in subjects with IGT</p> <p>Design and setting: Finnish Diabetes Prevention Study. RCT clinical trial. Mean follow-up was 3.2 years</p> <p>Participants: 522 middle aged, overweight adults. Mostly women (n= 355) Mean age = 55years. Most were overweight, mean BMI = 31.</p> <p>Intervention(s): Individualised counselling aimed at reducing weight, total intake of fat, saturated fat intake, and increasing the intake of fibre and physical activity. Seven counselling sessions in the first year, regular 3-monthly sessions after that during which goals were set for weight loss of 5%, decreasing fat intake <30% of energy, saturated fat <10%, increased fibre intake (15g per 1000kcal), and moderate exercise (endurance and/or supervised resistance training). DIET: Advice included more frequent ingestion of whole-grain products, fruits and vegetables, low-fat milk and meat products, soft margarines, and vegetable oils rich in monounsaturated fatty acids. 3-day food records were completed by each person, four times per year. PHYSICAL ACTIVITY: Endurance exercise: walking, jogging, swimming, aerobic ball games, skiing. Supervised individually-tailored, circuit-type resistance training sessions. Aimed to improve aerobic capacity and strength of large muscle groups. High repetitions, frequent 1 minute rest breaks between stations in the</p>	<p>Outcome measures: type 2 diabetes, weight loss.</p> <p>Results: Risk of type 2 diabetes reduced by 58% in the intervention group (11% in intervention, 23% in control). Mean weight loss at 1 year was 4.2kg (intervention) and 0.8 kg (control). After 2 years was 3.5kg (intervention) and 0.8kg (control). Weight loss of 4.7% was maintained in the intervention group after 3.2 years.</p> <p>Conclusion: Type 2 diabetes can be prevented by lifestyle changes in high-risk subjects.</p>

	circuit. Participation at 1 year was between 50-85% at different centres.	
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Diabetes 3.

Bibliographic information	Design & Methods	Findings
<p>Title: Does a combined program of dietary modification and physical activity or the use of metformin reduce the conversion from impaired glucose tolerance to type 2 diabetes?</p> <p>Authors: Trial: Pan XR, Li GW, Hu YH, et al. Effect of diet and exercise in prevention NIDDM in people with impaired glucose tolerance: the Da Qing IGT and diabetes study. Diabetes Care, 1997, vol. 20, pp. 537-544.</p> <p>Date: 2003.</p> <p>Publications details: MJA, vol. 178, pp. 346-349.</p>	<p>Design and setting: RCT Da Qing IGT and Diabetes Study, China. Randomised by clinic to one of 3 groups: diet-only, exercise-only, or diet plus exercise. 6 year follow-up.</p> <p>Participants: 577 subjects with IGT from 33 health care clinics. Mean age 46.5 yrs. Mean BMI=26. Slightly less than half were women.</p> <p>Intervention(s): Individual and group counselling. DIET: Recommended diet similar to Australian Dietary Guidelines (10-15% energy from protein, 25-30% from fat, 55-60% from carbohydrate, reduce intake of simple sugars, eat more vegetables, control alcohol intake). Emphasis on gradual weight loss. PHYSICAL ACTIVIVITY: Increase PA by at least two units per week. (One unit=30 mins slow walking)</p>	<p>Outcome measures: Type 2 diabetes (twice yearly 2hr glucose tolerance test repeated after 2 hrs)</p> <p>Results: Reductions in risk were: diet (31%), exercise only (46%), diet plus exercise (42%). No significant differences between intervention groups. But, compared to controls, the incidence of diabetes in the intervention groups was between 25-50% lower. No weight reduction observed amongst lean persons, minimal weight loss amongst overweight people.</p> <p>Conclusion: Increasing physical activity and altering the diet reduced the progression of IGT to Type 2 diabetes. Combining physical activity with dietary modification was not more efficacious than altering one component alone. ** NB: Limitations in study design and intervention including the small magnitude of physical activity increases (Mackerras 2003)</p>

Diabetes 4.

Bibliographic information	Design & Methods	Findings
<p>Title: Long-term (5-year) effects of a reduced fat diet intervention in individuals with glucose intolerance.</p> <p>Authors: Swinburn BA, Metcalf PA and Ley SJ.</p> <p>Date: 2001.</p> <p>Publications details: Diabetes Care, vol. 24, no. 4, pp. 619-624.</p>	<p>Research objective: To determine whether reducing dietary fat would reduce body weight and improve long-term glycemia in people with IGT.</p> <p>Design and setting: New Zealand . One year RCT of reduced fat ad libitum diet versus usual diet. 5 year follow-up.</p> <p>Participants: 176 men and women</p> <p>Intervention(s): 1 year structured education program, with monthly small group education sessions focused on reducing fat content, goal setting, and self-monitoring using food diaries.</p>	<p>Outcome measures: weight, BMI, fasting glucose, 2-h glucose, fasting insulin, 2-h insulin.</p> <p>Results: Compared with the control group, the reduced fat diet group lost more weight (3.3kg at one year, 3.2 kg at 2 years, 1.6 kg at 3yrs) and had a lower proportion of type 2 diabetes or IGT at one year (47% versus 67%). No differences were found at 5 year follow-up.</p> <p>Conclusion: The natural history for people at high risk of developing type 2 diabetes is weight gain and deterioration in glucose tolerance. This process may be ameliorated through adherence to a reduced fat intake.</p>

Diabetes 5.

Bibliographic information	Design & Methods	Findings
<p>Title: Walking compared with vigorous physical activity and risk of type 2 diabetes in women.</p> <p>Authors: Hu F, Sigal R., Rich-Edwards W., V, Solomon C et al</p> <p>Date: 1999</p> <p>Publications details: Journal of the American Medical Association, Vol. 282, il.5, pp. 1433-1447.</p>	<p>Research objective: To examine the relationship of physical activity and incidence of type 2 diabetes in women and to compare the benefits of walking vs. vigorous activity as predictors of subsequent risk.</p> <p>Design and setting: Prospective cohort study. US Nurses Health Study.</p> <p>Participants: Approx. 70,000 female nurses free of diabetes, CVD and cancer at baseline. Followed from 1986-92. Age 40-65 years.</p> <p>Intervention(s): Women completed self-report PA questionnaires at baseline, at 2yrs, and 6yrs.</p>	<p>Outcome measures: Type 2 diabetes</p> <p>Results: As physical activity increased (in intensity and duration), the risk of diabetes decreased. The dose response relationship was consistent in those with low and high-risk for diabetes. This effect remained significant even after adjusting for body weight (BMI). Effect was dependent on total energy expenditure rather than whether this was obtained through either walking or vigorous activity.</p> <p>Just over 3 hrs of vigorous exercise reduces the risk by 46%. Three hours a week of brisk walking reduces the risk by 42%. That is, a daily brisk walk of 30 mins approximately halves the risk of type 2 diabetes in women.</p> <p>Conclusion: Greater physical activity level is associated with substantial reduction in risk of type 2 diabetes, including activity of moderate intensity and duration.</p>

Diabetes 6.

This intervention from Stockholm, Sweden, is yet to be fully evaluated. It is included because it is a landmark, community-wide intervention which takes a comprehensive, multi-level, intersectoral approach to diabetes prevention.

Bibliographic information	Design & Methods	Findings
<p>Title: A stage model for assessing a community-based diabetes prevention program in Sweden</p> <p>Authors: Andersson C., Bjara G., Ostenson C.</p> <p>Date: 2002.</p> <p>Publications details: Health Promotion International, Vol. 17, No.4, pp.317-27.</p>	<p>Research objective: To reflect on the development and implementation of the Stockholm Diabetes Prevention Program as well as its interaction with the intervention communities.</p> <p>Design and setting: Prospective study. A community based intervention in 3 intervention municipalities in Stockholm county. This article reports on the 5 year process evaluation.</p> <p>Participants: Focused on the adult population. Multi-sector involvement of agencies and individuals in the intervention.</p> <p>Intervention(s): The Stockholm Diabetes Prevention Program is an extensive, intersectoral program involving local authorities from three municipalities in planning, initiation and implementation. It has adopted a multiple-risk factor approach to diabetes prevention focused on physical inactivity, obesity, poor dietary habits and tobacco smoking. The project has involved the development of an intersectoral coalition and smaller local steering groups comprised of: local government (departments of environment, social welfare, culture and recreation, and building and planning); primary health care (hospitals and medical practitioners); local NGOs (sports and fitness organisations, occupational health care, social insurance office, unemployment board) and; private sectors (food suppliers, restaurants, local mass</p>	<p>Outcome measures: Intermediate outcomes in the control and intervention communities will be measured using baseline and monitoring surveys of physical activity participation, body weight, dietary habits and tobacco consumption in selected target groups. The long-term outcome of reduced type 2 diabetes will be measured in the 10 year follow-up study.</p> <p>Results: No outcome evaluation has been conducted to date. Process and impact evaluation indicates:</p> <p>ENVIRONMENTS AND POLICY: Significant political and economic support has been mobilised; local governments and medical boards have written plans for health promotion work. <u>Physical activity:</u> local investments have improved access to physical activities; new walking and cycling paths with signs and free route maps for existing ones have been constructed; local government have increased support for sporting organisations to provide easier and cheaper access to facilities. Calendar of activities developed to represent all local sporting organisations; an activity suitcase for groups of council staff containing education materials, heart rate monitors and pedometers. Walking sticks available free from council. <u>Healthy eating:</u> healthy restaurant projects include a contest for the healthiest restaurant; community catering introduced a healthy lunch with a 'green keyhole' symbol. <u>Smoking:</u> active promotion of non-smoking restaurants; policy to encourage smoke-free dining.</p>

	<p>media, businesses and industries).</p> <p>Intervention components include: information, policy development, improvements to economic, social and physical environments, and setting up networks for prevention. The goal of the program is to reduce diabetes by 25% and a follow-up evaluation will be conducted after 10 years of the intervention. Multi-level interventions have been developed and implemented by community coalitions and smaller committees w</p> <p>Implementation factors (key lessons learned): Influence local authorities to create supportive policies; facilitate intersectoral collaboration; engage local politicians and decision-makers; incorporate programs into municipal structures; local government appreciate the relevance of these intermediate targets for other health issues; include high level representatives from local government on local steering groups to encourage commitment from local government and ease local adoption of the program and its components; allow communities and organizations to take over program ownership as early as practicable and integrate activities into the ordinary agenda; leadership (from the program and community) is of great importance in effectively initiating and maintaining activities which engage politicians and key decision-makers.</p>	<p>COMMUNITY ACTION: Local steering groups have maintained intersectoral involvement for 5 years. Local networks utilising community leaders have worked to raise awareness about the risk of being sedentary and for planning community activities.</p> <p>HEALTH INFORMATION: Posters, pamphlets, exhibitions, internet home pages developed. Local media cover all program activities and planned ones.</p> <p>EDUCATION: Prescription initiatives to decrease physical inactivity, obesity, tobacco use. Educational programs tailored to disadvantaged groups: those with long term sickness, unemployment or sedentary occupations.</p> <p>Conclusion: Over the period of the program, interest and responsibility has grown at the municipal authorities. The program and its activities have strengthened the engagement on the political and administrative levels for health promotion issues. Community adoption of the program over the long term seems attainable.</p>
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Diabetes 7.

Bibliographic information	Design & Methods	Findings
<p>Title: Nutrition and prevention of type 2 diabetes.</p> <p>Authors: Costacou T and Mayer-Davis EJ.</p> <p>Date: 2003.</p> <p>Publications details: Annual Review of Nutrition, vol. 23, pp. 147-170.</p>	<p>Research objective: Systematic review of the evidence of the effect of diet on insulin resistance, insulin secretion and glucose tolerance. Reflects on directions for future work in primary prevention of type 2 diabetes.</p> <p>Findings: There is strong evidence that decreased energy intake, reduced fat intake, weight loss and regular participation in physical activity reduce the risk of type 2 diabetes.</p> <p>In people with high blood fats, more calories should be obtained from mono-saturated fats than from carbohydrates. Whereas for those who are overweight, carbohydrate should increase and intake of total fat should decrease (to recommended levels of 25%). Preliminary evidence exists for a protective effect of whole grains and dietary fibre intake against diabetes development. Thus, dietary carbohydrate from plant-derived foods should be preferred to the high-sugar items currently dominating the food market.</p>	<p>Conclusions and recommendations: Both obesity and physical activity are the most important contributors to the development of type 2 diabetes.</p> <p>There is strong evidence for the following recommendations:</p> <ol style="list-style-type: none"> 1. Individuals at risk for developing type 2 diabetes should participate in structured lifestyle modification programs – including education, reduced fat and energy intake, regular physical activity and regular participant contact. This can produce long-term weight loss of 5-7% of starting weight and reduce the risk of developing diabetes. 2. All individuals, especially family members of persons with type 2 diabetes, should be encouraged to engage in regular physical activity to decrease the risk of developing type 2 diabetes.

Diabetes 8.

National Health and Medical Research Council 2001, *Evidence-based Guidelines for Type 2 Diabetes: Primary Prevention, Case Detection and Diagnosis*, NHMRC, Sydney.

Risk factor	Evidence statements
Obesity	<p>Contributory factors:</p> <p>Many studies have demonstrated the importance of obesity in adult life as an independent risk factor in the development of type 2 diabetes, particularly for men.</p> <p>The evidence to date indicates that obesity in adult life increases the risk of diabetes; this risk increases according to the magnitude of the obesity and the length of time a person has been obese.</p> <p>Weight gain in adult life also increases the risk.</p> <p>People with impaired glucose tolerance (IGT) are more likely to progress to type 2 diabetes if they are obese.</p> <p>Weight loss is associated with reduced progression of IGT to type 2 diabetes.</p> <p>Interventions:</p> <p>An intervention program of combined diet and exercise is more effective in maintaining weight loss than either diet alone or exercise alone.</p> <p>Targeted dietary and exercise programs based on an empowerment model comprising diabetes awareness sessions, exercise groups and cooking demonstrations have prevented weight gain in a high risk population (overweight adults).</p> <p>Although body weight can be easily lost during a program, it is often regained during the subsequent, unsupervised period.</p> <p>Long-term weight loss has been successfully maintained by both men and women who report consumption of a low fat, low energy diet.</p> <p>Specific population groups:</p> <p>In men taught dietary and exercise strategies, waist circumference may decline and remain reduced for up to 2 years.</p> <p>Overweight men with IGT who followed a long-term program of diet and exercise had reduced all-cause mortality after a period of 12 years.</p> <p>In women, an ad libitum low fat diet is superior to a low energy diet in maintaining weight after a major weight loss.</p>
Physical activity	<p>Contributory factors:</p> <p>There is strong evidence that, for both men and women, physical activity reduces the risk of type 2 diabetes.</p> <p>Exercise programs can slow the progression of IGT to type 2 diabetes and, in men, have been shown to reduce diabetes-related mortality.</p> <p>The protective effect of physical activity is more pronounced for men who are obese but it is as effective in older men as in younger men.</p> <p>The risk declines as exercise frequency increases to 3-5 times per week.</p> <p>Several studies indicate that moderate activity, such as brisk walking for 30 minutes per day, can be as beneficial as vigorous activity, particularly for women.</p>

	<p>Interventions:</p> <p>There is strong evidence that physical activity decreases the risk of type 2 diabetes.</p> <p>There is some evidence to show that as the quantity of physical activity increases so does the protective effect - although resistance training and high-intensity exercise is contra-indicated for people with high blood pressure. . However, other studies suggest moderate activity may be as beneficial as vigorous activity and more research is needed on this question, particularly for women.</p> <p>Combined dietary and physical activity interventions are more effective than either intervention conducted separately. Combined interventions can reduce the progression of IGT to type 2 diabetes by up to 58%.</p> <p>Specific population groups:</p> <p>The association between diabetes risk and physical activity has been much less frequently studied for women than men. Although studies show that physical activity can reduce the risk of diabetes to 0.67 of the risk experienced by non-exercisers, more research is required.</p>
<p>Nutrition</p>	<p>Contributory factors:</p> <p>There is moderately strong evidence that dietary fat, particularly, saturated fat, has an effect on the development of type 2 diabetes.</p> <p>There is good evidence that unsaturated fat of vegetable origin may have a protective or neutral effect.</p> <p>There is some evidence that fish and mono-saturated fats may have a protective effect but more research is required.</p> <p>In people with high blood fats, more calories should be obtained from mono-saturated fats than from carbohydrates. Whereas for those who are overweight, carbohydrate should increase and intake of total fat should decrease (to recommended levels of 25%).</p> <p>Preliminary evidence exists for a protective effect of whole grains and dietary fibre intake against diabetes development. Thus, dietary carbohydrate from plant-derived foods should be preferred to the high-sugar items currently dominating the food market (Costacou and Mayer-Davis 2003).</p> <p>There is also some evidence that fish has a protective effect.</p> <p>Interventions:</p> <p>Long term compliance with an ad libitum low fat diet has been shown to improve glucose tolerance and reduce the risk of IGT progression to type 2 diabetes.</p> <p>The effects of a combined low-fat diet and physical activity intervention can reduce risk by up to 58%.</p>
<p>Gestational diabetes:</p>	<p>Contributory factors:</p> <p>There is good evidence that gestational diabetes is associated with the risk of future type 2 diabetes in the mother and probably obesity and type 2 diabetes in the offspring.</p> <p>Women with GDM in a previous pregnancy may have increased risk of GDM in subsequent pregnancies. There is evidence to suggest a relationship between low birth weight and type 2 diabetes later in life.</p> <p>Interventions:</p> <p>It is unknown whether treatment to reduce hyperglycemia in the mother would reduce the risk of future type 2 diabetes. No further information is provided about interventions.</p>

Psychosocial stress:	Contributory factors: More research is needed to explore the impact of psychosocial stress on the development of type 2 diabetes. More sensitive measures are required examine the links between stress and type 2 diabetes. There is evidence to show that exposure to stressful events may increase risk and this risk may be mitigated if people receive social support. Specific population groups: Diabetes is more prevalent amongst minority and disadvantaged groups. There is increasing evidence from correlational studies that the psychosocial stress and social conditions associated with low income and education may be associated with development of type 2 diabetes and people's ability to manage the disease effectively. Consequently, targeted interventions for these groups are required.
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